

### ABSTRACT OF THE DISCLOSURE

Optical transmitter/receivers for use in a DWDM systems are provided.

Transmission of data signals in a quadrature-return-to-zero (QRZ) format achieves a data transmission rate equal to eight times a base data rate, i.e., 80 Gbps over a 100 GHz channel if the base data rate is 10 Gbps, with high non-linear performance by setting the polarization state of the data bands such that non-linear effects induced by PMD are reduced. Additionally, a transmitter achieves a transmission data rate equal to 16 times the base data rate by sharpening the QRZ pulses and interleaving pulse-sharpened QRZ data signals in the time domain, further doubling the data rate. Using counterpropagation in the transmitter, carrier signals and data signals traverse the same length of fiber, reducing fringing effects in the transmitter. Related techniques enhance reception and detection of data at high data rates. A local pulse-sharpened carrier is mixed with a QRZ data signal at a detector reducing amplification noise by a factor of two. A bi-directional Erbium-doped fiber amplifier is used to amplify a carrier signal while limiting fringing effects by sending carrier and data signals along equal optical path lengths. Non-linear effects are reduced by transmitting carrier signals in an orthogonal polarization state with respect to data signals, and PMD phase noise effects are compensated for in both single channel and DWDM multi-channel systems by using delay management.